

REMARKS

Claim 6 has been amended in order to more particularly point out, and distinctly claim the subject matter to which the applicants regard as their invention. The applicants respectfully submit that no new matter has been added. It is believed that this Amendment is fully responsive to the Office Action dated **December 9, 2003**.

Claim Objections

Claim 6 is objected to because of informalities. Taking the Examiner's comments into consideration, claim 6 has been amended. Therefore, withdrawal of the objection to claim 6 is respectfully requested.

Claim Rejections under 35 USC §103

Claims 6-10 are rejected under 35 USC §103(a) as being unpatentable over Yamamoto et al. (U.S. Patent No. 5,520,269) in view of Uramoto et al. (U.S. Patent No. 4,642,011) and Hufnagl et al. (U.S. Patent No. 4,221,041).

The pin of the connection structure of the present invention has the following characteristics.

(1) The pin is the complete hollow pin through which its center hole penetrates, and has the shaft portion which does not have a step on the outer surface of the intermediate portion. (2) A rounded, namely, circular convex shape is previously formed in part of an inner peripheral surface of an end portion of this hollow pin by beveling. (3) An outer peripheral surface of the pin is not beveled, but

in an angular shape as shown in FIGS. 4A, 4C, 4E, 4F and 4G of the present invention. (4) The pin is surface-treated, and has a hard surface-treated layer. (5) The spring is provided between the washer at the caulking side and the washer at the hub/disc side, and these washers are flat and have no steps. (6) In order to connect the hub and the disc, the pin end portion having the hard surface-treated layer is subjected to roller caulking and deformed. (7) Deformation of the pin end portion after caulking is very small, and the inner diameter portion of the pin end portion is smaller than the outer diameter of the shaft portion. The angular outer peripheral surface of the pin end portion does not abut to the upper surface of the washer.

On the other hand, the rivet in Hufnagl et al. (USP 4,221,041) of the cited reference is a semi-hollow pin suitable for press caulking by the Forming dies (34) in such a shape as shown in FIG. 1, and is solid other than the caulked portion. The inner peripheral surface and the outer peripheral surface of the end portion of this rivet at the caulked side are formed in the convex shape. Since the rivet of Hufnagl et al. is solid other than the caulked portion, press-caulking can be performed by the Forming dies 34, the material of the rivet end portion is charged in the inner peripheral surface of the counter sink 30 provided in the laminate, and the outer peripheral surface of the rivet end portion abuts to the inner peripheral surface of the counter sink 30.

If the complete hollow pin, as in the present invention, is to be press-caulked by the Forming dies 34, the caulking itself cannot hold good because the material moves into the hollow portion of the pin. Thus, it is not easy or obvious for even a person skilled in the art to apply the shape of the rivet end portion, which is characterized for press-caulking of the solid rivet of Hufnagl et al, to

roller caulking for the hollow pin.

The end portion of the rivet of Hufnagl et al. is large in extension of the material by caulking, and the inner diameter portion of the rivet end portion after caulking becomes larger than the outer diameter of the shaft portion. If the surface treatment is previously performed for the rivet of Hufnagl et al., the surface-treated film of the end portion of the rivet is broken by the extension of the material, and the under material surface is exposed. There is no description or suggestion of flaw prevention at the end portion of the rivet in Hufnagl et al.

The pin of Yamamoto et al. (USP5,520,269) of the cited reference has the step portion in the intermediate portion of the shaft, and the thickness of the caulked side from the step portion is made small. This is to widen the diameter of the end portion of the pin to be large by caulking, and to position the stepped washer by utilizing the step portion of the shaft. The pin of the present invention does not have the step portion at the shaft portion. In the pin of Yamamoto et al., the convex shape is not formed at the inner peripheral surface, but is formed at the outer peripheral surface. This is because the end portion is significantly deformed by caulking and the outer peripheral surface of the end portion abuts to the upper surface of the washer, and the washer is damaged if the outer peripheral surface is in an angular shape. In the pin of the present invention, the convex shape is not formed at the outer peripheral surface, but at the inner peripheral surface of the end portion. The pin of the present invention has less deformation of the end portion by caulking, and the outer peripheral surface of the end portion does not abut to the upper surface of the washer. Therefore, the outer peripheral surface is not in the convex shape, but is in the angular shape,

and the inner peripheral surface is in the convex form to prevent breakage of the surface-treated film by caulking. Yamamoto et al. discloses the springs provided at the fixed flange side of the pin and provided at the caulked flange side. The spring provided at the caulked flange side cannot exhibit the original property of the spring by 100 % since its intermediate portion abuts to the stepped washer. Since the pin of the present invention is not stepped, the washer at the caulked side is not stepped but flat, and the spring abuts to the washer at its tip end (inner end in the radial direction), and exhibits the original property of the spring by 100%,

In Hufnagl et al. and Yamamoto et al., the deformation amounts of the end portions by caulking are both large, and the inner diameter portions of the caulked end portions are made remarkably larger than the outer diameters of the small diameter portions of the shaft portions. In the present invention, widening of the inner diameter of the pin end portion by caulking is very small and does not exceed the outer diameter of the shaft portion, as described above. In the pin of the present invention, the thickness of the shaft portion is even and does not have a step on the outer peripheral surface. The beveled portion forming the convex circular shape is provided at part of the inner peripheral surface at the pin end portion before caulking, and the beveled portion is not provided at the outer peripheral surface of the end portion of the pin and the outer peripheral surface is angular. The wall of the angular outer peripheral portion at the end portion of the pin is widened by a very small caulking amount, and engages with the flat washer having no step. The inner diameter of the end portion after caulking is smaller than the outer diameter of the shaft portion. Since the caulking amount is very small, by providing the convex shape at the inner peripheral

surface of the end portion, stress concentration is prevented at the time of caulking and a crack in the surface-treated film can be prevented, and there is no fear that the under material surface is exposed.

Summarizing the above, the applicant considers that even if Hufnagl et al., Yamamoto et al. and Uramto et al. (USP4,642,011) of the cited references are combined, the operational effects of the present invention cannot be expected, and that the present invention cannot be easily achieved.

Therefore, withdrawal of the rejection of Claims 6-10 under 35 USC §103(a) as being unpatentable over Yamamoto et al. (U.S. Patent No. 5,520,269) in view of Uramoto et al. (U.S. Patent No. 4,642,011) and Hufnagl et al. (U.S. Patent No. 4,221,041) is respectfully requested.

Conclusion

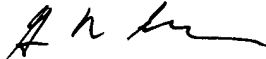
In view of the aforementioned amendments and accompanying remarks, claim 6, as amended, are in condition for allowance, which action, at an early date, is requested.

If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact Applicants undersigned attorney at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully submitted,

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